APPROVED PROCEDURES
FOR MAKING MIL-STD-826A CONDUCTED MEASUREMENTS
USING INTERFERENCE ANALYZERS EMC-10 & EMC-10E

These procedures provide for semi-automated conducted tests per Method 3001 of MIL-STD-826A using the Interference Analyzers Model EMC-10E and Model EMC-10 with Electro-Scan Control Unit Model ESC-10A. EMC-10 and EMC-10E are approved (Category A) for measurements to MIL-STD-826 or other specifications used on Air Force contracts. Inquiries regarding use of this procedure should be directed to the cognizant Air Force representative.

MP MASTER
MA30040

FAIRCHILD
ELECTRO-METRICS
CORPORATION
A SUBSIDIARY OF FAIRCHILD CAMERA
AND INSTRUMENT CORPORATION

88 CHURCH ST., AMSTERDAM, NEW YORK 12011

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APPROVED PROCEDURE FOR

USE OF INTERFERENCE ANALYZER MODEL EMC-10E

FOR MAKING CONDUCTED MEASUREMENTS TO MIL-STD-826A

(See Procedure B for making tests with EMC-10 and ESC-10A)

Method 3001 in MIL-STD-826 and MIL-STD-826A calls for the use of instrumentation of the Interference Analyzer Model EMC-10E type for measuring narrowband and broadband conducted interference in wires and cables.

Method 3001 requires that electromagnetic interference currents in the frequency range from 30 Hz to 14 kHz shall not appear on any conductor that can carry interference to other equipments or sub-systems higher than the limits shown in MIL-STD-826, Method 1001. (See Method 3001 as described in MIL-STD-826 for detailed requirements.)

The specific equipment list for this test as called out in the specification includes the following:

(1) a current probe

(2) a matching transformer

(3) a bandpass filter

(4) a broadband and selective VTVM

(5) a low-pass filter

(6) harmonic filters

Included in the EMC-10E is circuitry representing all of these equipments except for the current probe and the harmonic filters. The Fairchild/Electro-Metrics Clamp-on Probe Model PCL-10 is normally used with the EMC-10E. Harmonic filters are not manufactured by Fairchild/Electro-Metrics but may be obtained from other sources. The matching transformer is built into the EMC-10E; the bandpass filter, recommended as 50 Hertz when running narrowband tests per this specification, is one of its built-in selective filters, and the EMC-10E also has a low-pass 20 kHz filter as required. The Model EMC-10E also incorporates built-in electronic scanning for automatic sweeping of the frequency range and simultaneous recording on an X-Y plotter.

As a result, both narrowband and broadband measurements can be met by the use of the following equipment and accessories:

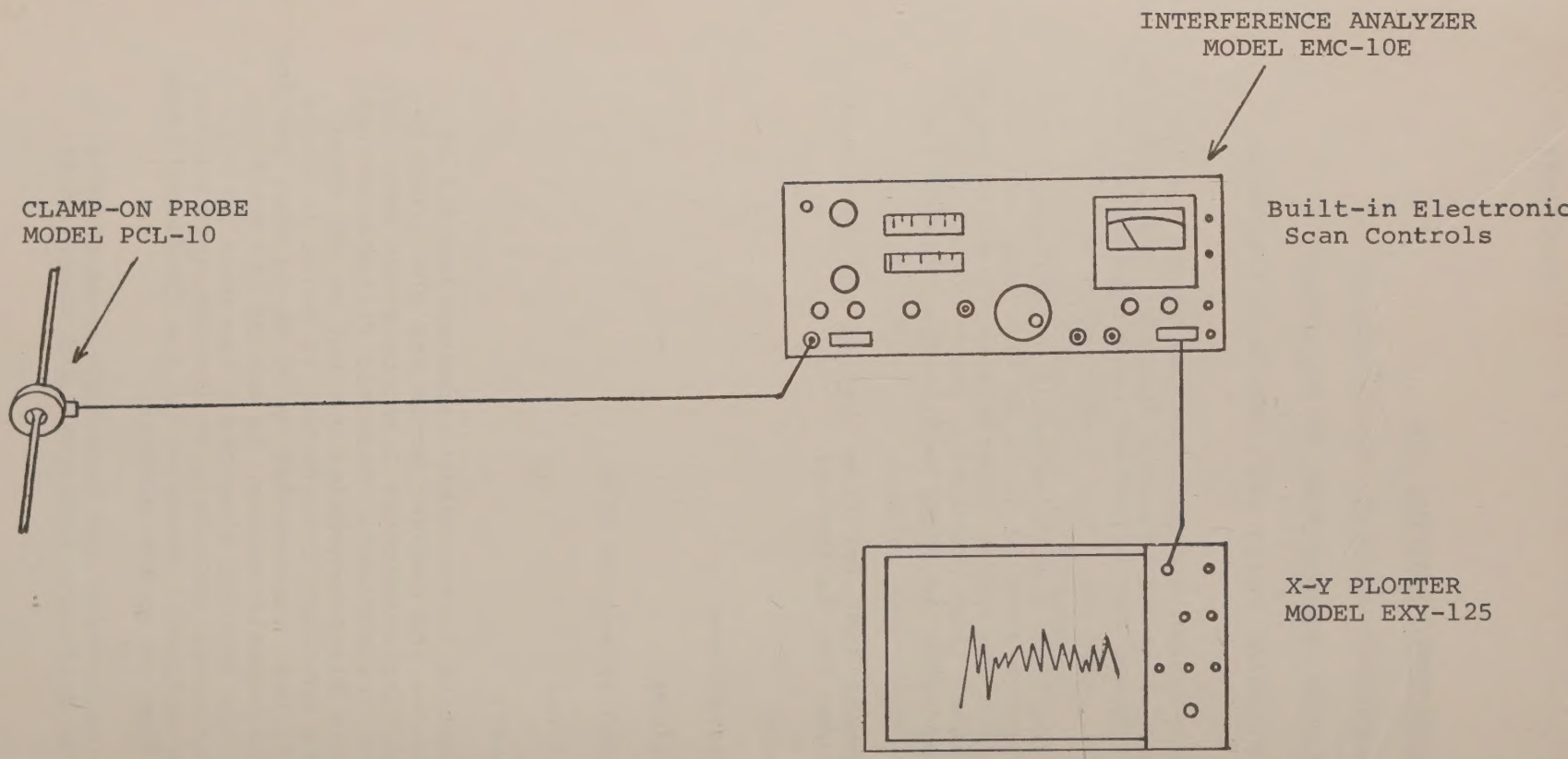

Figure 1A - TYPICAL TEST SET-UP FOR MAKING CONDUCTED NARROWBAND INTERFERENCE MEASUREMENTS USING FAIRCHILD/ELECTRO-METRICS' INTERFERENCE ANALYZER MODEL EMC-10E, CLAMP-ON PROBE MODEL PCL-10 and X-Y PLOTTER MODEL EXY-125.

(1) Fairchild/Electro-Metrics Interference Analyzer Model EMC-10E.

(2) Fairchild/Electro-Metrics Clamp-on Probe Model PCL-10.

(3) Fairchild/Electro-Metrics Coaxial Cable, Model CAC-10 or equivalent.

(4) EMC-10 to EXY-125 Interconnecting Cable, Model XYC-10.

(5) Fairchild/Electro-Metrics X-Y Plotter Model EXY-125.

(6) Fairchild/Electro-Metrics Clamp-on Probe Amplifier Model PCA-10 or Genistron Current Probe Amplifier Model GHP-305.

(7) A second coax cable with BNC male connectors is required when using the Clamp-on Probe Amplifier.

(8) Fairchild/Electro-Metrics 60 Hz Rejection Filter Model NRF-10 and/or 400 Hz Rejection Filter Model NRG-10, and or other Harmonic Filters, as required.

Harmonic filtering may be required when making the broadband measurements in order to remove power supply harmonics of the power frequency. A passive harmonic filter is used in the RF line between the Clamp-on Probe and the receiver to provide a sharp notch rejection of the primary power (usually 60 Hz or 400 Hz) and its first 2 or more harmonics. In some cases only removal of the fundamental may be required in which case the above listed Fairchild filter is suggested. Other sources either have or will soon have harmonic filters to remove a number of harmonics of the fundamental power frequency.

If desired, and approved by the Air Force, the test can be performed without using the automatic scanning feature in which case the EMC-10E is manually tuned with the X-Y Plotter automatically following. (It can also be electronically scanned from an outside voltage source other than the built-in circuitry.)

For narrowband measurements the typical test setup is per the Figure 3001-1 in MIL-STD-826 and as shown in Figure 1A. For broadband measurements the setup requires the addition of the Clamp-on Probe Amplifier between the Current Probe and the input connector of the EMC-10E, the addition of harmonic filtering, if required, as described above, and disconnection of the X-Y Plotter. See Figure 2A.

To complete the requirements per these typical set-ups under MIL-STD-826 it is also necessary to connect to the EMC-10E an X-Y plotter, which must meet MIL-STD-826 requirements if it is to be used in a screen room.

A fundamental requirement of MIL-STD-826 is that the instrument must be amplitude calibrated for "peak" in terms of RMS of the equivalent sine wave. Other specifications require amplitude calibration with the detector function switch in the "carrier" position, and this is the method described in the EMC-10E Instruction Manual. This results in calibration of the instrument such that the instrument is calibrated for "average" in terms of RMS of the equivalent sine wave. Because of the requirement for "peak" calibration in MIL-STD-826, the EMC-10E is calibrated as usual except that the detector function switch is in the PEAK position rather than in the CARRIER position. This results in "peak" calibration in terms of RMS of the equivalent sine wave, as required. In essence, the resulting calibration is 3 dB lower than when calibrated for "carrier" (or average.)

AMPLITUDE CALIBRATION PROCEDURE FOR EMC-10E

In order to amplitude calibrate the EMC-10E proceed as follows:

A. Turn on EMC-10E and permit a 15-minute warm-up.

B. Disconnect RF input cable.

C. Set FREQUENCY control at any point between 1 kHz and 10 kHz.

D. Set IMPEDANCE switch at 50 ohms.

E. Set low-pass FILTER at 20 kHz.

F. Adjust BANDWIDTH switch to 50 Hz.

G. Set output control at CAL-TRACKING.

H. Set detector function switch at +PEAK.

I. Adjust both WIDEBAND and SELECTIVE RANGE controls to read CAL (Both fully clockwise)

J. Adjust GAIN control to full scale indication.

The instrument is now amplitude calibrated to provide "peak" readings in terms of RMS of the equivalent sine wave for the 50 Hertz bandwidth.

FREQUENCY CALIBRATION USING EMC-10E WITH X-Y PLOTTER

After amplitude calibrating the EMC-10E as described above, proceed to frequency calibrate as follows:

A. Switch BANDWIDTH control to 5 Hz position.

B. Change FREQUENCY indication to 00000.

C. Adjust gray "zero" control knob (on shaft) very carefully for maximum null on front panel meter. Δ F control may be used for final adjustment. Meter indicator will bounce because of +PEAK readings.

D. At maximum null the instrument is frequency calibrated.

E. Turn OFF EMC-10E and connect X-Y plotter to EMC-10E using Interconnecting Cable Model EXY-125 or equivalent.

F. Turn EMC-10E and X-Y Plotter ON.

G. Insert pre-printed limit graph paper Form 009 for the 30 Hertz to 14 kHz conducted measurements.

H. Adjust the front panel counter on the EMC-10E to 30 Hz.

I. Adjust the plotter pen of the X-axis to the left zero position of the X-Y plotter using the ZERO control on the plotter.

J. Adjust the front panel FREQUENCY indicator of the EMC-10E to 14 kHz.

K. Adjust the pen on the X-Y plotter to the full scale position on the X-axis using the plotter X-axis GAIN control. (Plotter probably will be set in 0.1 volt per inch RANGE position.) Two or more adjustments may be necessary.

X-Y PLOTTER AMPLITUDE CALIBRATION

A. Leaving the EMC-10E in the 14 kHz position, connect a coax cable from the EMC-10E output BNC connector to the EMC-10E INPUT BNC connector with the LEVEL control turned fully CCW.

B. Switch BANDWIDTH switch to WIDEBAND.

C. Switch the EMC-10E WIDEBAND RANGE CONTROL to read 1 volt.

FAIRCHILD
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CORPORATION
AMSTERDAM, NEW YORK

MIL-STD-826
NARROW BAND
CONDUCTED LIMITS
30 Hz - 14 KHz

Data Page No. _____

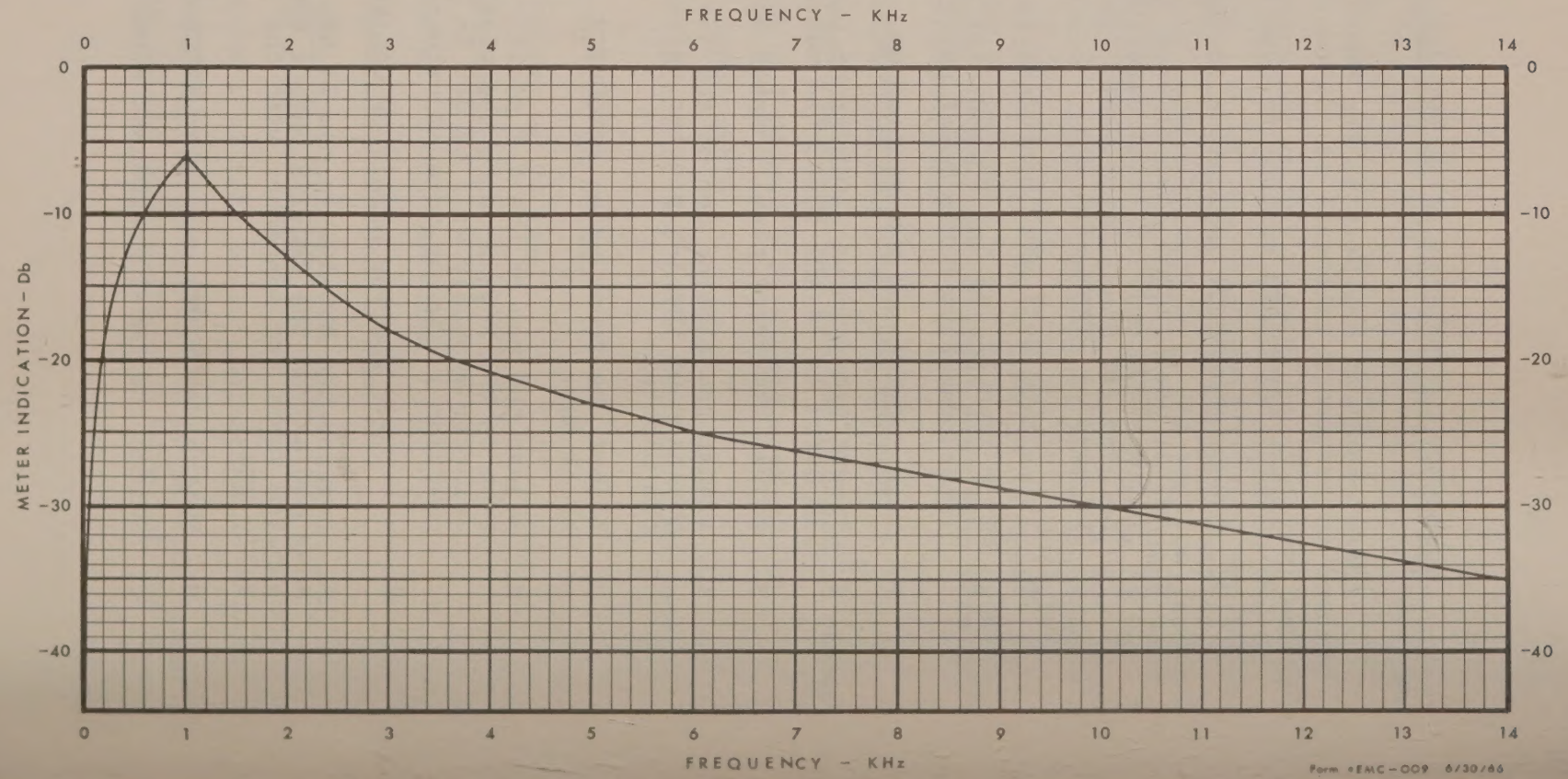
Company: _____

Test Specimen: _____ **Technician:** _____ **Date:** _____

Test Set up: ☐ EMC-10E with PCL-10 and X-Y Plotter or ☐ EMC-10 with ESC-10, PCL-10 and X-Y Plotter

Serial No. of EMC-10 or EMC-10E: _____ **Latest Calibration Date:** _____ **Scan Speed: 10 KHz/min.**

GRAPH LIMIT INCLUDES FIGURE 1001-1 (MIL-STD-826) LIMITS AND PCL-10 CONVERSION FACTOR. BANDWIDTH 50 Hz.
SEE INSTRUCTIONS FOR OTHER RECEIVER CONTROL SETTINGS, SYSTEM SET UP AND PROCEDURE.



Form #EMC-009 6/30/66

D. Adjust the LEVEL control to -40 dB on the EMC-10E meter carefully. Some bounce of the meter will occur because of operation in +PEAK position.

E. Adjust ZERO of Y-axis on the X-Y plotter to the -40 dB line on the X-Y graph.

F. Adjust LEVEL control to full scale on the meter.

G. Adjust the Y-axis GAIN control to full scale on the X-Y graph. This procedure may have to be repeated two or three times before the plotter is properly adjusted.

H. When the X-Y Plotter is properly adjusted, turn the LEVEL control to -20 dB on the meter scale. The pen should now be very close to the -20dB line on the X-Y pre-printed graph. If not, adjust the ZERO control of the Y-axis slightly until it is on the -20 dB line.

I. Switch back to full scale on the meter with the LEVEL control and make a slight adjustment if necessary to the Y-axis GAIN control on the X-Y plotter.

This procedure may have to be repeated two or three times to properly adjust the plotter.

NARROWBAND MEASUREMENTS

To make narrowband measurements to Method 3001 of MIL-STD-826, using EMC-10E and an X-Y Plotter, continue procedure as follows:

A. Disconnect the cable from the INPUT of the EMC-10E.

B. Return the FREQUENCY counter on EMC-10E to 30 Hz.

C. Connect the current probe around the cable to be tested.

D. Using Coax Cable CAC-10 or equivalent, connect the output of the current probe to the INPUT connector of the EMC-10E.

E. Adjust the WIDEBAND attenuator to read 1 Volt (+120 dB).

F. Switch BANDWIDTH control to 50 Hz position and adjust the SELECTIVE attenuator to 100 millivolts (100 dB).

G. Turn on the AUTO SCAN switch. Press the START button which is just above the AUTO SCAN switch.

The scan will now start at approximately 1000 Hz below the front panel counter reading, i.e. -1000 Hz. During this period the X-Y plotter pen will hug the left side of the plotter. As the scan reaches the 30 Hertz low end point setting, the pen will start plotting, and will continue until it reaches the right hand side of the plotter. First, lift recorder pen and then turn off the AUTO SCAN switch and the Plotter in order to prevent smearing of the graph.

If at no point the reading goes over the limit line on the pre-printed graph paper, the MIL-STD-826 requirement is met for narrowband conducted measurements on the cable being tested from 30 Hz to 14 kHz per Method 3001.

Because the combined characteristics of the Clamp-on Probe and the MIL-STD-826 Narrowband Conducted Measurements specification result in a limit curve on the graph EMC-009 that varies over 30 dB, the maximum point is as high as only 6 dB below the top of the graph paper, which is somewhat marginal. As a result, it is required that if on the resulting curve, signals in the range of 30 Hz to 2 kHz have peaks above -15 dB, the operator should proceed as follows:

A. Adjust SELECTIVE attenuator to 1 Volt position (to add 20 dB input attenuation).

B. Turn on X-Y Plotter.

C. Turn on AUTO SCAN Switch. Press the start button above the AUTO SCAN switch, hold until the X-Y plotter is at X-axis zero position, lower pen and release.

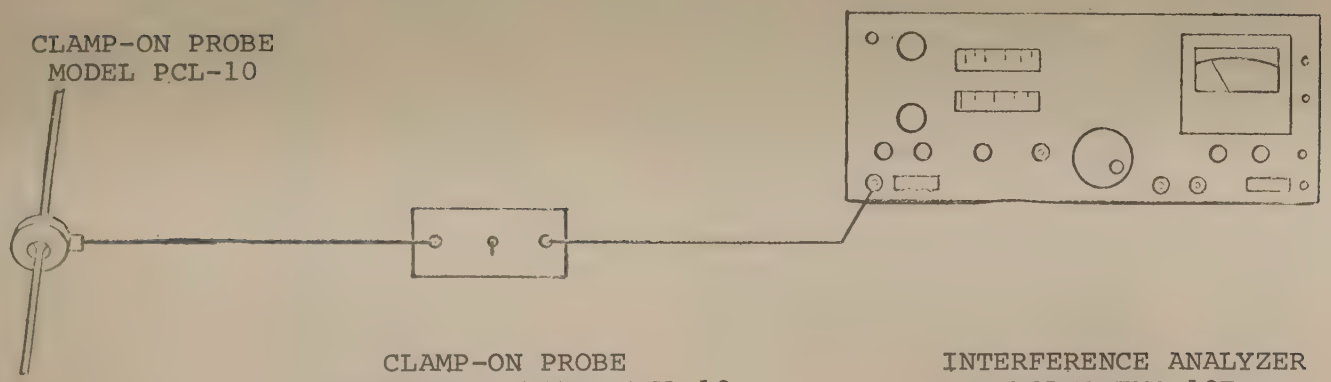
The instrument will now electronically re-scan from 30 Hz to 14 kHz but this time with the resulting signal levels at 20 dB below the original graph curve.

As a result, the marginal area between 30 Hertz and 2 kHz can be more carefully evaluated to assure specification compliance. All signals must now be drawn at least 20 dB below the limit line on the graph.

TESTING FOR BROADBAND SIGNALS PER MIL-STD-826

To run the Broadband test on conducted limits from 30 Hertz to 14 kHz, the EMC-10E with the current probe are required, plus a current probe amplifier such as the Fairchild/Electro-Metrics Model PCA-10 or the Genistron Model GHP-305. The X-Y Plotter is not required.

CLAMP-ON PROBE WITH AMPLIFIER
PROVIDES FLAT UNITY INPUT TO
RECEIVER, i.e.: 1 uV = 1 uA



Maximum Reading: $\frac{\text{120 dB (Attenuator) -20 dB (Meter)}}{\text{20 kHz}} =$

$\frac{\text{100 dB}}{\text{1/50 MHz}} = \frac{\text{100 dB + 34 dB}}{\text{1 MHz}} = \text{134 dB uA/MHz}$

Figure 2A - TYPICAL TEST SET-UP FOR MAKING CONDUCTED BROADBAND INTERFERENCE MEASUREMENTS USING FAIRCHILD/ELECTRO-METRICS' INTERFERENCE ANALYZER MODEL EMC-10E, CLAMP-ON PROBE MODEL PCL-10 and CLAMP-ON PROBE AMPLIFIER MODEL PCA-10.

Because the broadband specifications do not apply at the power frequency, it is necessary to reduce the level of the primary power frequency fundamental so that the level of one or more other narrow or broadband signals becomes predominate in the 30 Hz to 14 kHz range. Extremely narrowband 60 Hz and 400 Hz rejection filters, such as Models NRF-10 and NRG-10 are available. They are interconnected between the Clamp-on Probe and the Probe Amplifier. MIL-STD-826 also calls for procuring activity waiver of the requirement for the 2, 3, 4 and 5th harmonics if a harmonic filter is to be used.

(Clamp-on Probe Amplifiers may be available in the future with built-in 60 Hz or 400 Hz notch filters eliminating the need for separate filters. Specifications will show the addition when and if the design change is made.)

The EMC-10E is amplitude and frequency calibrated in the same way as described above allowing a nominal 15 minutes for warm-up.

After calibrations are made, the front panel adjustments are to be as follows:

A. IMPEDANCE - 10k Ohms.

B. FILTER - 20 kHz

C. BANDWIDTH - Wideband

D. FREQUENCY - Anywhere between 30 Hz and 14 kHz.

E. WIDEBAND attenuator - In the 1 volt (120 dB) position.

F. Output Switch - IF -VIDEO

G. Detector Switch - +PEAK

Proceed as follows:

A. Connect the probe around the cable to be tested.

B. Output of the current probe is connected to the Current Probe Amplifier such as Fairchild/Electro-Metrics Models PCA-10 or the Genistron Model GHP-305.

C. Output of the current probe amplifier is fed to the INPUT Connector of the EMC-10E through Coax Cable CAC-10 or equivalent.

D. A single meter reading is made.

If the reading on the front panel meter is below -20 dB, the MIL-STD-826A requirement is met for Broadband conducted measurements on the cable being tested from 30 Hz to 14 kHz per Method 3001, MIL-STD-826A.

APPROVED PROCEDURE FOR

USE OF INTERFERENCE ANALYZER MODEL EMC-10 WITH

ELECTRO-SCAN CONTROL UNIT MODEL ESC-10A

FOR MAKING CONDUCTED MEASUREMENTS TO MIL-STD-826A

(See Procedure A for making tests with EMC-10E)

Method 3001 in MIL-STD-826 and MIL-STD-826A calls for the use of instrumentation of the Interference Analyzer Model EMC-10 type for measuring narrowband and broadband conducted interference in wires and cables.

Method 3001 requires that electromagnetic interference currents in the frequency range from 30 Hz to 14 kHz shall not appear on any conductor that can carry interference to other equipments or sub-systems higher than the limits shown in MIL-STD-826, Method 1001. (See Method 3001 as described in MIL-STD-826 for detailed requirements.)

The specific equipment list for this test as called out in the specification includes the following:

(1) a current probe

(2) a matching transformer

(3) a bandpass filter

(4) a broadband and selective VTVM

(5) a low-pass filter

(6) harmonic filters

Included in the EMC-10 is circuitry representing all of these equipments except for the current probe and the harmonic filters. The Fairchild/Electro-Metrics Clamp-on Probe Model PCL-10 is normally used with the EMC-10. Harmonic filters are not manufactured by Fairchild/Electro-Metrics but may be obtained from other sources. The matching transformer is built into the EMC-10; the bandpass filter, recommended as 50 Hertz when running narrowband tests per this specification, is one of its built-in selective filters, and the EMC-10 incorporates a low-pass 20 kHz filter as required. The Electro-Scan Control Unit Model ESC-10A makes possible electronic scanning of the frequency range.

As a result both narrowband and broadband measurements can be met by the use of the following equipment and accessories:

(1) Fairchild/Electro-Metrics Interference Analyzer Model EMC-10

(2) Fairchild/Electro-Metrics Electro-Scan Control Unit Model ESC-10A

(3) Fairchild/Electro-Metrics Clamp-on Probe Model PCL-10 or equivalent

(4) Fairchild/Electro-Metrics Coaxial Cable, CAC-10 or equivalent

(5) EMC-10 to ESC-10 Interconnecting Cable

(6) ESC-10 to EXY-125 Interconnecting Cable

(7) Fairchild/Electro-Metrics X-Y Plotter Model EXY-125 or equivalent

(8) Fairchild/Electro-Metrics Clamp-on Probe Amplifier Model PCA-10 or Genistron Current Probe Amplifier Model GHP-305

(9) A second coax cable with BNC male connectors is required when using the clamp-on probe amplifier.

(10) Fairchild/Electro-Metrics 60 Hz Rejection Filter Model NRF-10 and/or 400 Hz Rejection Filter Model NRG-10 and/or other Harmonic Filters, as required.

Harmonic filtering may be required when making the broadband measurements in order to remove power supply harmonics of the power frequency. A passive harmonic filter is used in the RF line between the Clamp-on Probe and the receiver to provide a sharp notch rejection of the primary power (usually 60 Hz or 400 Hz) and its first 2 or more harmonics. In some cases only removal of the fundamental may be required in which case the above listed Fairchild filter is suggested. Other sources either have or will soon have harmonic filters to remove a number of harmonics.

The Electro-Scan Control Unit Model ESC-10A is included to make possible fully automated electronic scanning of the frequency range when making narrowband measurements. It provides for setting of frequency end-points, scan rate control, start-stop control, sector-scanning, and automatic pen lift for the X-Y plotter.

If desired, and approved by the Air Force, the test can be performed without the ESC-10A in which case the EMC-10 X-Y outputs are connected directly to the Plotter and the EMC-10 manually tuned. (It can also be electronically scanned from a voltage other than the ESC-10A.)

For narrowband measurements the typical test setup is per the Figure 3001-1 in MIL-STD-826 and as shown in Figure 1B. For broadband measurements the setup requires the addition of the Clamp-on Probe Amplifier between the Current Probe and the input connector of the EMC-10, the addition of harmonic filtering, if required, as described above and disconnection of the X-Y Plotter. See Figure 2B.

To complete the requirements per this typical set-up under MIL-STD-826 it is also necessary to connect to the regular EMC-10 model the Electro-Scan Control Unit Model ESC-10A to provide automatic electronic scanning, and to this control unit, an X-Y plotter which must meet MIL-STD-826 requirements if it is to be used in a screen room.

A fundamental requirement of MIL-STD-826 is that the instrument must be amplitude calibrated for "peak" in terms of RMS of the equivalent sine wave. Other specifications require amplitude calibration with the detector function switch in the "carrier" position, and this is the method described in the EMC-10 Instruction Manual. This results in calibration of the instrument such that the instrument is calibrated for "average" in terms of RMS of the equivalent sine wave. Because of the requirement for "peak" calibration in MIL-STD-826, the EMC-10 is calibrated as usual except that the detector function switch is in the PEAK position rather than in the CARRIER position. This results in "peak" calibration in terms of RMS of the equivalent sine wave, as required. In essence, the resulting calibration is 3 dB lower than when calibrated for "carrier" (or average).

AMPLITUDE CALIBRATION PROCEDURE FOR EMC-10

In order to amplitude calibrate the EMC-10 proceed as follows:

A. Turn on EMC-10 and permit a 15-minute warm-up.

B. Disconnect RF input cable.

C. Set FREQUENCY control at any point between 1 kHz and 10 kHz.

D. Set IMPEDANCE switch at 50 ohms.

E. Set low-pass FILTER at 20 kHz.

F. Adjust BANDWIDTH switch to 50 Hz.

G. Set output control at CAL-TRACKING.

H. Set detector function switch at +PEAK.

I. Adjust both WIDEBAND and SELECTIVE RANGE controls to read CAL (Both fully clockwise).

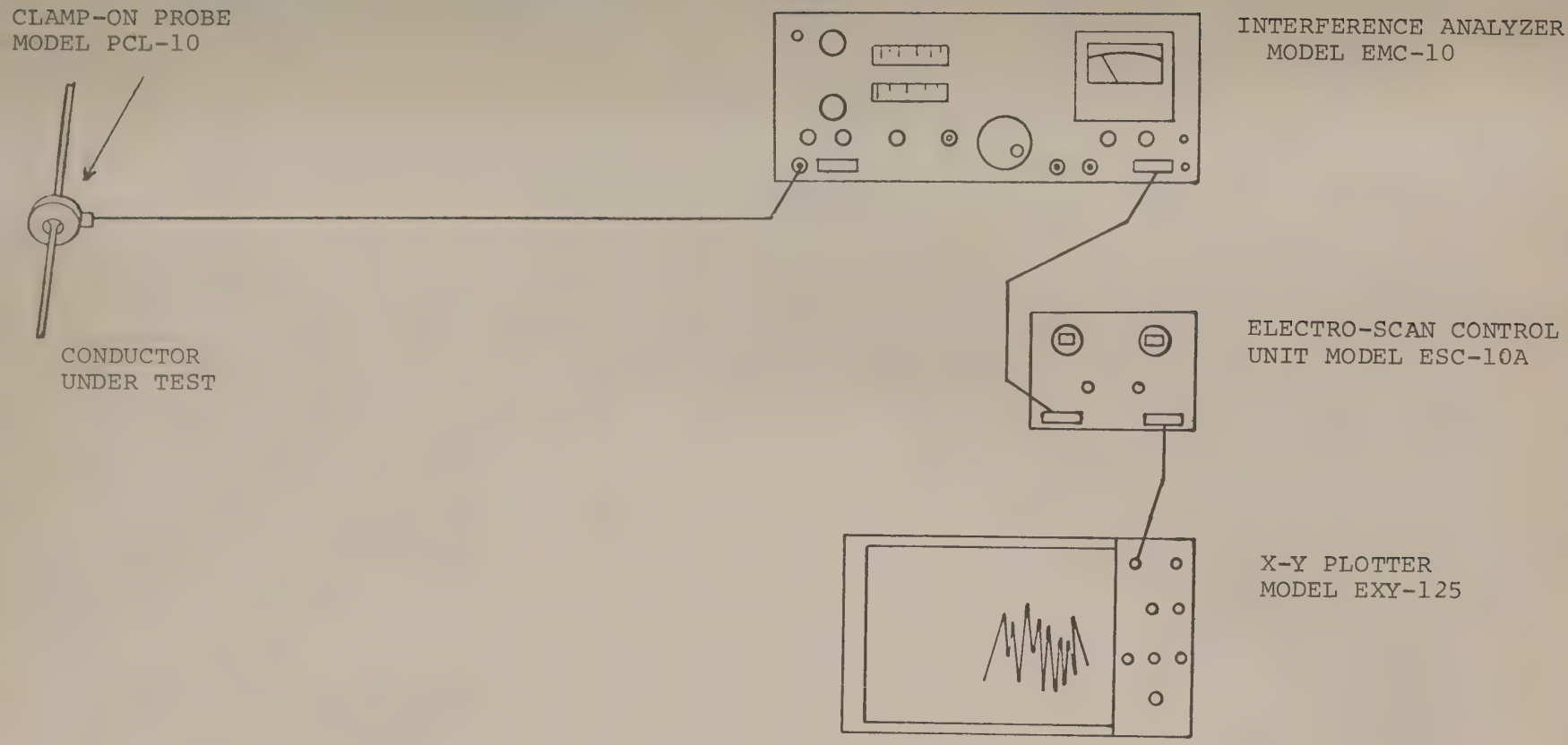


Figure 1B - TYPICAL TEST SET-UP FOR MAKING CONDUCTED NARROWBAND INTERFERENCE MEASUREMENTS USING FAIRCHILD/ELECTRO-METRICS' INTERFERENCE ANALYZER MODEL EMC-10, ELECTRO-SCAN CONTROL UNIT MODEL ESC-10A, CLAMP-ON PROBE MODEL PCL-10 AND X-Y PLOTTER MODEL EXY-125.

J. Adjust GAIN control to full scale indication.

The instrument is now amplitude calibrated to provide "peak" readings in terms of RMS of the equivalent sine wave for the 50 Hertz bandwidth.

FREQUENCY CALIBRATION WHEN USING ESC-10A WITH X-Y PLOTTER

If the EMC-10 is being used with the Electro-Scan Control Unit Model ESC-10A and an X-Y Plotter, interconnect these units and proceed as follows:

Starting with the EMC-10 controls set as described for amplitude calibration above, and the ESC-10A switch position to "EMC-10", make the following changes in order to frequency calibrate the EMC-10:

A. Switch BANDWIDTH control to 5 Hz position.

B. Change FREQUENCY indication to 00000.

C. Adjust gray ZERO control knob (on shaft) very carefully for maximum null on front panel meter. Δ F control may be used for final adjustment. Meter indicator will "bounce" because of +PEAK readings.

D. At maximum null the instrument is frequency calibrated.

E. Turn X-Y Plotter ON.

F. Insert pre-printed limit graph paper Form 009 for the 30 Hertz to 14 kHz conducted measurements.

G. Adjust EMC-10 front panel FREQUENCY indicator to read 30 Hertz.

H. Adjust plotter pen position of the X-axis to the left zero position of the plotter using plotter X-axis ZERO control.

I. Adjust front panel FREQUENCY indicator of EMC-10 to 14 kHz.

J. Adjust pen of plotter to X-axis full scale using X-axis GAIN control. (Most plotters will require a RANGE setting of 0.1 volt per inch.)

(Repeat steps G through J if required to properly adjust Plotter X-axis.)

K. Switch Electro-Scan ESC-10A to CAL-HIGH position and scan rate position to M.

L. Adjust Electro-Scan ESC-10A to right-hand side frequency control until plotter is again positioned at full scale on the X-axis.

FAIRCHILD
ELECTRO-METRICS CORPORATION
AMSTERDAM NEW YORK

MIL-STD-826
NARROW BAND
CONDUCTED LIMITS
30 Hz - 14 KHz

Data Page No. _____

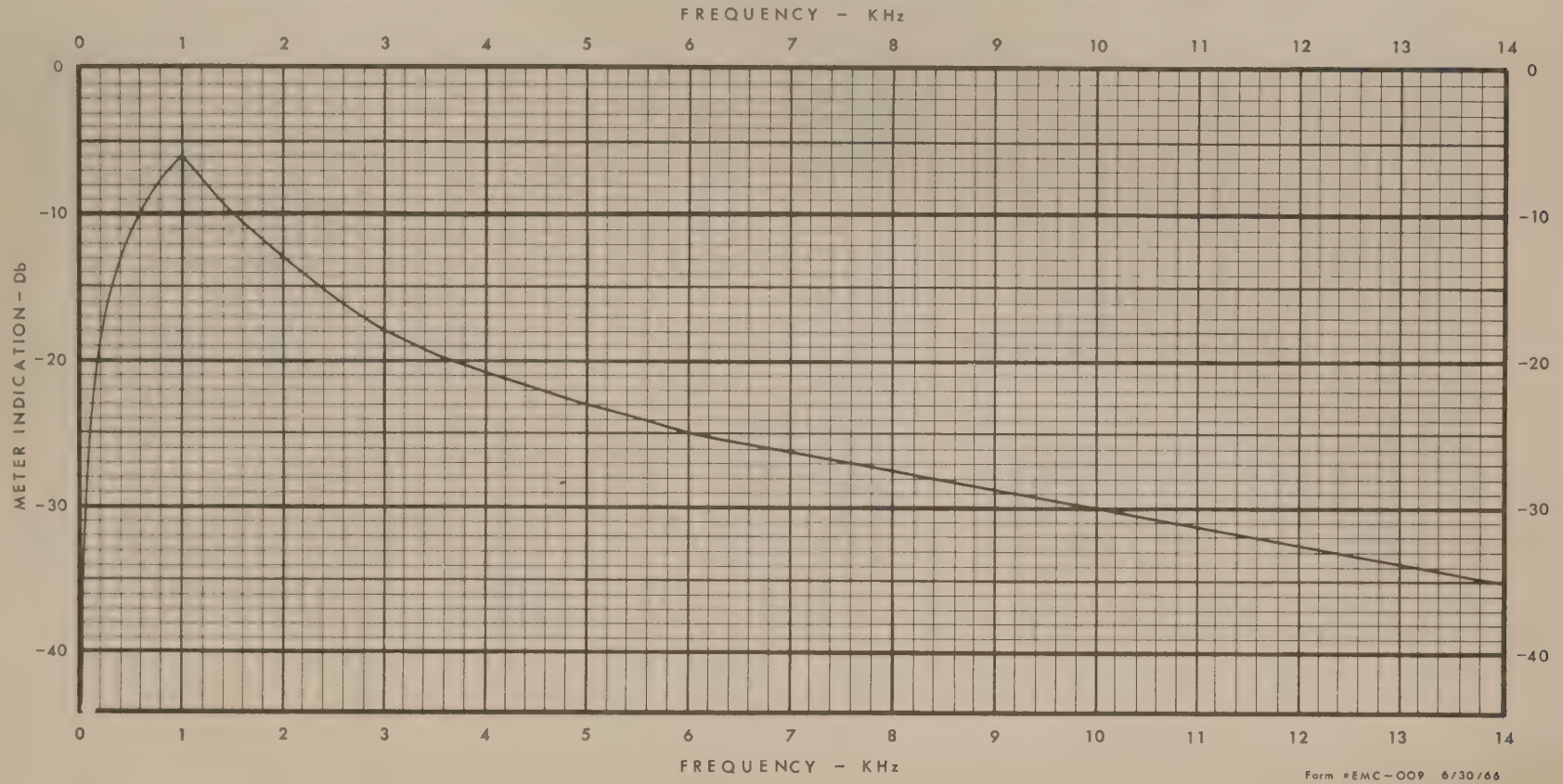
Company: _____

Test Specimen: _____ **Technician:** _____ **Date:** _____

Test Set up: ☐ EMC-10E with PCL-10 and X-Y Plotter or ☐ EMC-10 with ESC-10, PCL-10 and X-Y Plotter

Serial No. of EMC-10 or EMC-10E: _____ **Latest Calibration Date:** _____ **Scan Speed: 10 KHz/min.**

GRAPH LIMIT INCLUDES FIGURE 1001-1 (MIL-STD-826) LIMITS AND PCL-10 CONVERSION FACTOR. BANDWIDTH 50 Hz.
SEE INSTRUCTIONS FOR OTHER RECEIVER CONTROL SETTINGS, SYSTEM SET UP AND PROCEDURE.



Form #EMC-009 6/30/66

M. Switch ESC-10A to CAL-LO and adjust ESC-10A left-hand frequency control knob until the pen is at the zero position on the X-axis of the plotter.

(Repeat Steps K through M if required to properly adjust Plotter X-axis.)

X-Y PLOTTER AMPLITUDE CALIBRATION

A. Switch the ESC-10A to "MAIN" or "EMC-10".

B. Leaving the EMC-10 in the 14 kHz position, connect a coax cable from EMC-10 function output BNC connector to EMC-10 INPUT BNC connector with LEVEL control turned fully CCW.

C. Switch BANDWIDTH switch to WIDEBAND.

D. Re-position WIDEBAND RANGE control setting to 1 volt.

E. Adjust LEVEL control on the EMC-10 carefully until meter reading is at -40 dB on the meter scale. Some bounce of the meter will occur because of operation in +PEAK position.

F. Adjust ZERO of Y-axis to the -40 dB line on the X-Y graph.

G. Adjust LEVEL control to full scale on the meter.

H. Adjust plotter to Y-axis full scale using Y-axis GAIN control.

Two or three more re-adjustments may be necessary at -40 dB and full scale.

I. Once the plotter is adjusted properly between the full scale and the -40 dB lines, adjust output of LEVEL control until meter reads -20 dB.

J. Pen on X-Y Plotter should now be very close to the -20 dB line. If it is not, adjust the ZERO control on the Y-axis slightly until the pen is aligned at -20 DB. Re-adjust LEVEL control to full scale.

Here, again, two or more re-adjustments may be necessary between full scale and -20 dB to get exact match between meter reading and Y-axis readings on the graph.

NARROWBAND MEASUREMENTS

To make narrowband measurements to Method 3001 of MIL-STD-826, using EMC-10, ESC-10A and an X-Y Plotter, continue procedure as follows:

A. Disconnect BNC connector at EMC-10 INPUT.

B. Position current probe about wire or cable to be tested.

C. Using Coax Cable CAC-10 or equivalent, connect Current Probe to EMC-10 INPUT connector.

D. Adjust WIDEBAND attenuator to read 1 Volt (120 dB).

E. Switch BANDWIDTH control to 50 Hz position and adjust SELECTIVE attenuator to 100 mV (100 dB).

F. Switch Electro-Scan ESC-10A to START position, hold until X-Y plotter is at X-axis zero position and release.

The instrument will now electronically scan from 30 Hertz to 14 kHz the range of the pre-printed graph paper, in approximately 100 seconds.

G. Lift recorder pen and turn OFF X-Y Plotter.

If at no point the reading goes above the limit line on the pre-printed graph paper, the MIL-STD-826 requirement is met for narrowband conducted measurements on the cable being measured from 30 Hertz to 14 kHz per Method 3001.

Because the combined characteristics of the Clamp-on Probe and the MIL-STD-826 Narrowband Conducted Measurements specification result in a limit curve on the graph EMC-009 that varies over 30 dB, the maximum point is as high as only 6 dB below the top of the graph, which is somewhat marginal. As a result, it is required that if, on the resulting graph, signals in the range of 30 Hz to 2 kHz have peaks above -15 dB, the operator should proceed as follows:

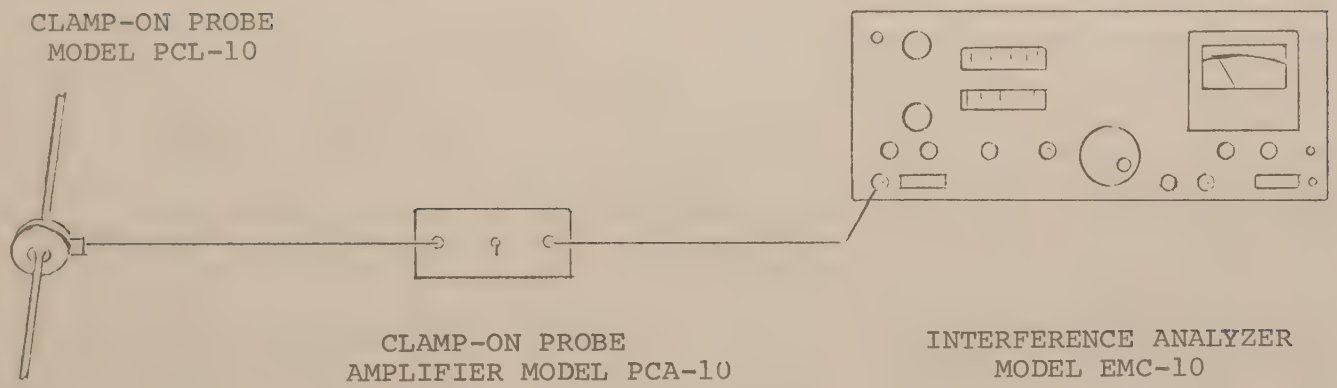
A. Adjust SELECTIVE attenuator to 1 Volt position (to add 20 dB input attenuation.)

B. Turn on X-Y Plotter.

C. Switch Electro-Scan ESC-10A to START position, hold until X-Y Plotter is at X-axis zero position, lower pen and release. The instrument will now electronically re-scan from 30 Hertz to 14 kHz but this time with the resulting signal levels at 20 dB below the original graph.

As a result, the marginal area between 30 Hertz and 2 kHz can be more carefully evaluated to assure specification compliance. All signals must now be drawn at least 20 dB below the limit line on the graph.

CLAMP-ON PROBE WITH AMPLIFIER
PROVIDES FLAT UNITY INPUT TO
RECEIVER, i.e.: 1 uV - 1 uA



Maximum Reading: $\frac{\text{120 dB (Attenuator) -20 dB (Meter)}}{\text{20 kHz}} =$

$$\frac{\text{100 dB}}{\text{1/50 MHz}} = \frac{\text{100 dB + 34 dB}}{\text{1 MHz}} = \text{134 dB uA/MHz}$$

Figure 2B - TYPICAL TEST SET-UP FOR MAKING CONDUCTED BROADBAND INTERFERENCE MEASUREMENTS USING FAIRCHILD/ELECTRO-METRICS' INTERFERENCE ANALYZER MODEL EMC-10, CLAMP-ON PROBE MODEL PCL-10 AND CLAMP-ON PROBE AMPLIFIER MODEL PCA-10.

TESTING FOR BROADBAND SIGNALS PER MIL-STD-826A

To run the Broadband test on conducted limits from 30 Hertz to 14 kHz, an EMC-10 with the current probe are required, plus a current probe amplifier such as the Fairchild/Electro-Metrics Model PCA-10 or the Genistron Model GHP-305. The X-Y Plotter is not required.

Because the broadband specifications do not apply at the power frequency, it is necessary to reduce the level of the primary power frequency fundamental so that the level of one or more other narrow or broadband signals become predominate in the 30 Hz to 14 kHz range. Extremely narrowband 60 Hz and 400 Hz Rejection filters, such as Models NRF-10 and NRG-10, are available from Fairchild and other sources. They are interconnected between the Clamp-on Probe and the Probe Amplifier. MIL-STD-826 also calls for procuring activity waiver of the requirement for the 2, 3, 4 and 5th harmonics if a harmonic filter is to be used.

(Clamp-on Probe Amplifiers may be available in the future with built-in 60 Hz or 400 Hz notch filters eliminating the need for separate filters. Specifications will show this addition when and if the design change is made.)

The EMC-10 is amplitude and frequency calibrated in the same way as described above allowing a nominal 15 minutes for warm-up.

After calibrations are made, the front panel adjustments are to be as follows:

A. IMPEDANCE - 10 k ohms

B. FILTER - 20 kHz

C. BANDWIDTH - Wideband

D. FREQUENCY - Anywhere between 30 Hz and 14 kHz.

E. WIDEBAND attenuator - In the 1 volt (120 dB) position.

F. Output switch - IF - VIDEO

G. Detector Switch - +PEAK

Proceed as follows:

A. Connect the probe around the cable to be tested.

B. Output of the current probe is connected to the Current Probe Amplifier such as Fairchild/Electro-Metrics Model PCA-10 or the Genistron Model GHP-305 through Coax Cable Model CAC-10 or equal.

C. Output of the current probe amplifier is fed to the INPUT connector of the EMC-10 through a short piece of coax cable.

D. A single meter reading is made.

If the reading on the front panel meter is below -20 dB the MIL-STD-826A requirement is met for Broadband conducted measurements on the cable being tested from 30 Hz to 14 kHz per Method 3001, MIL-STD-826A.

EXPLANATORY INFORMATION

NARROWBAND MEASUREMENTS

The limit line as printed on Form 009 combines the Conversion Graph of the Clamp-on Probe Model PCL-10 as shown in the EMC-10 instruction manual and the MIL-STD-826 specification for conducted limits as shown in Figure 1001-1 of that specification.

For example, the Conversion Graph in the instruction manual indicates that 26 dB is to be added to the instrument reading at 1 kHz to convert that voltage reading to amperes on a one to one basis.

Thus: An Instrument reading of 10 uV (20 dB) would be added to 26 dB.

10 uV + 26 dB =

20 dBuV + 26 dB = 46 dBuV

The limit of MIL-STD-826 is 120 dBuV thus this signal would be well below the limit.

Using Form 009 and the procedure outlined, the attenuator of the EMC-10 is set at 100 mV (100 dB) and the EMC-10 meter reading must be below -6 dB for a final reading of 94 dBuV or less at 1 kHz.

94 dBuV + 26 dB (1 kHz conversion factor) = 120 dBuA
which is the MIL-STD-826 limit

At 2 kHz as a second example, the conversion graph of the manual calls for the addition of 20 dB to the meter reading to convert to amperes. At this frequency the MIL-STD-826 limit is 107 dBuA. Thus the Form 009 limit is:

107 dBuA -20 dB = 87 dBuA

With the attenuator setting on 100 dBuV as called out in the instructions, the meter must read below -13 dB as shown on the Form 009, or

100 dB - 13 dB = 87 dBuA
the specification limit.

BROADBAND MEASUREMENTS

The broadband limit per MIL-STD-826A is flat from 30 Hz to 14 kHz. Thus, if the characteristic of the Clamp-on Probe were not frequency sensitive and would present a flat broadband output, no compensation would be needed and only a single reading would have to be made encompassing this frequency range.

Because the Clamp-on Probe is frequency sensitive, the Clamp-on Probe Amplifier is designed to complement its frequency response and provide a one ohm transfer impedance device that not only provides a flat output over the frequency range as seen by the Clamp-on Probe but simultaneously makes possible direct voltage to amperage conversion with a minimum loss of sensitivity.

As a result, the measurement can be made in such a way that the limit is a single meter reading on the EMC-10, providing that controls are properly set according to the instructions given.

The Broadband Specification limit is 134 dBuA/MHz. The instructions call for setting the EMC-10 attenuator at 1 volt (120 dB). A meter reading is required to be below -20 dB or a total of 100 dB. The bandwidth, however, is only 20 kHz so that the reading in Broadband terms is 100 dB/uA/20 kHz. 20 kHz is 1/50th of one MHz which is 34 dB difference in bandwidth.

Thus, the true reading is

$$100 \text{ dB} + 34 \text{ dB} = 134 \text{ dBuA/MHz}$$

It should be noted that while the 20 kHz low pass FILTER switch is activated, 20 kHz is a 3 dB point and any signals between 14 kHz and 20 kHz are considered insignificant unless they are shown to be unusually significant from the narrowband testing results in this frequency range.

In order to assure that more than just the peaks of the fundamental and major harmonics of the power in a line are being measured, particularly if the broadband signal level is marginal, or above the limit, the use of harmonic filters between the Clamp-on Probe and Amplifier is recommended. In many cases a single, narrow filter to reject the fundamental is adequate if the use of such a filter reduces the reading to below the specification limit. This is possible because the limit in this specification does not apply to the fundamental frequency.

Filters to remove the 2, 3, 4 and 5th harmonics either are or soon will be on the market. Special Air Force waiver, however, is required to permit ignorance of these harmonics in making the measurements.

AVAILABILITY OF FORM 009

While the Form 009 used for making the narrowband automated test per MIL-STD-826 is available from Fairchild Electro-Metrics Corporation, 88 Church Street, Amsterdam, New York 12010, an EMC-10 user can easily make his own copies from a blank form.

Because the EMC-10 outputs are fully linear (in dB for amplitude, and in frequency) linear compression or expansion of either axis will not effect accuracy as long as the lines of the graph form are vertical and horizontal so that the X-Y plotter pen will properly trace the printed lines.

MP MASTER
MA30040